Space Weather Technical Forecast

Issued on Friday, 10 December 2021 at 12:35 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: No Significant Activity

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Very Low over the past 24 hours with no notable flares. There are no sunspots currently on the visible disc. No Earth-directed CMEs have been observed in the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind speed, as measured by DSCOVR and ACE at L1, was at background, declining from 360 to near 310 km/s. The density of the wind, was mostly at or just above average, but has been rising to reach 17ppcc at 10/1200 UTC. The Interplanetary Magnetic Field (IMF) strength, Bt, was weak below 5 nT, the north-south component (Bz) varied between +2/-4 nT. The phi angle was predominately positive (away from the Sun). Resultant geomagnetic activity during the period was Quiet (Kp 0-1). The first of the anticipated CME arrivals has now likely missed.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) remained at background levels. The high energy electron flux (greater than 2 MeV) generally moderate to high, with peak of 1281 pfu at 09/1740UTC. The associated 24-hour integrated fluence has been below the Active threshold throughout (1e8 integrated pfu), although with a very slightly increasing trend. 5.64e7 integrated pfu was observed at 10/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to stay predominantly Very Low during the forecast period, with the current absence of any regions on the visible disc.

Solar Wind / Geomagnetic Activity: A weak CME from a filament lift on the 6th has the potential to graze Earth on day 1 (10th). Otherwise, a weak fast wind enhancement is possible day 2 (11th), but otherwise solar winds are expected to persist at background levels. Geomagnetic activity is forecast to be mainly Quiet, with a chance of a period of Unsettled activity and a slight chance of isolated Active intervals from any CME arrival day 1 or early day 2 (10th or 11th). This increasing to Quiet to Unsettled with a chance of Active for a time later day 2 (11th).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is likely to continue varying between Moderate and High levels, however the associated 24-hour integrated fluence is expected to persist below the Active threshold.

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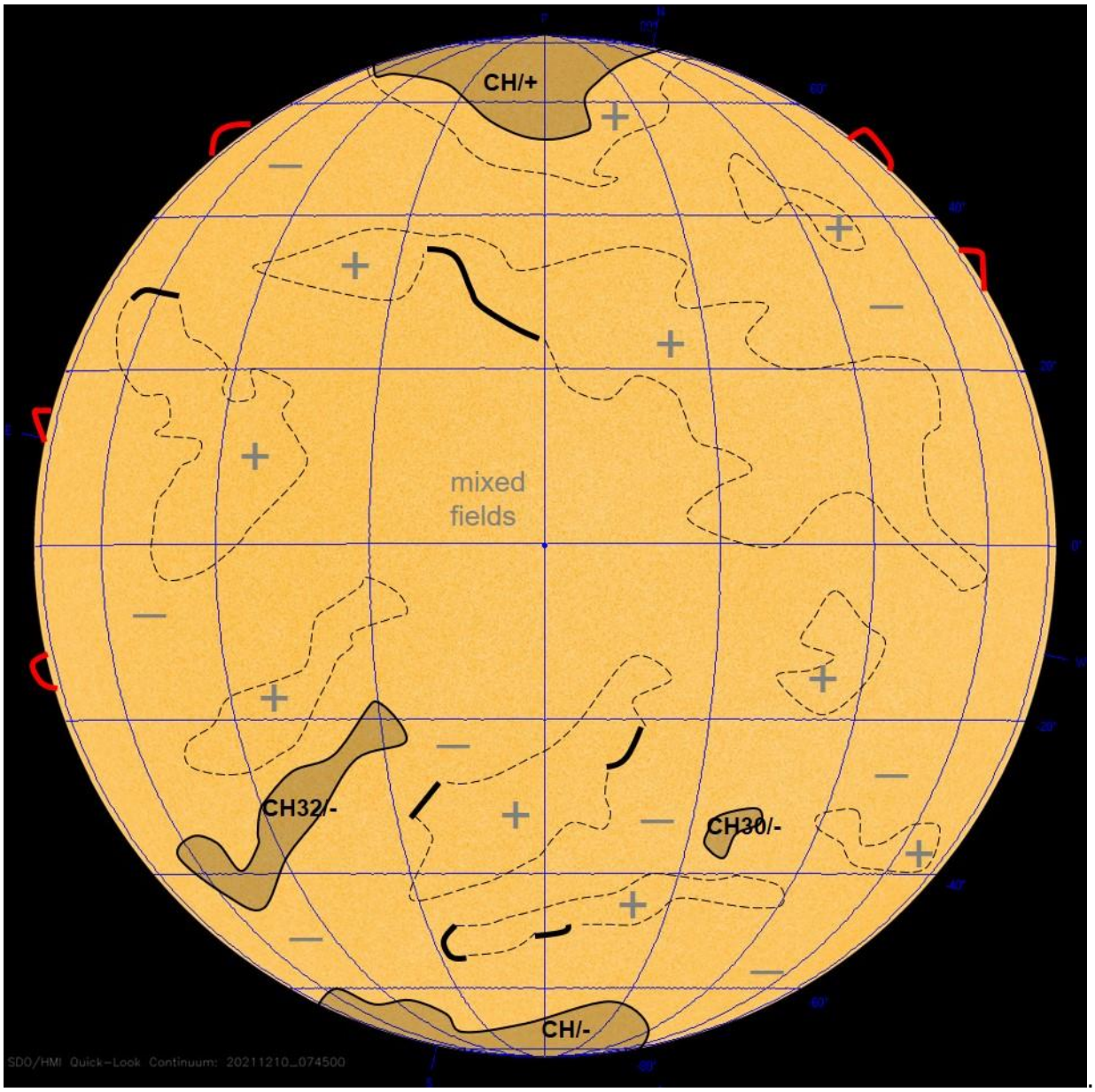
Figure 1. Solar Analysis Valid 10/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is still the potential for a weak CME to move across Earth later on the 10th (day 1), which is from a filament lift on the 6th. This brings a slight chance of increased geomagnetic activity later on day 1 or into day 2 (10th or 11th). Day 2 may also see the arrival of the fast wind of CH30/- in the southwestern disc. This is a small feature, and new to this rotation, with only a slight enhancement expected. This is supported by enlil, and also the lack of enhancement observed at STEREO A.

Coronal hole 32 is much reduced from the previous rotation, so whilst persistence would suggest a notable enhancement to near 600 km/s is possible day 4 (13th), any enhancement from this feature is currently forecast to occur day 5 (14th) beyond this forecast period.

Geomagnetic activity is forecast to be mainly Quiet, with the chance of a period of Unsettled activity and a slight chance of isolated Active intervals from the CME arrival day 1 or early day 2 (10th or 11th). This increasing to Quiet to Unsettled with a chance of Active for a time later day 2 (11th) from the influence of the fast wind of CH30/-. A further increase to Unsettled to Active is then possible later day 4 (13th), but most probably day 5 (14th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	1	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
06/1313	Partial	Filament	SE Quadrant	310km/s	10/0900 UTC	Limited Shock expected

Figure 2: Solar Wind Persistence Model

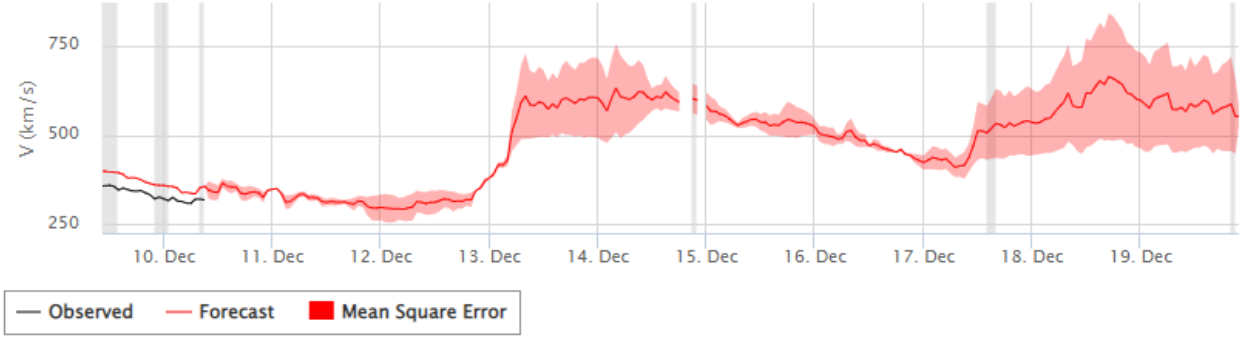

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Figure 3: SDO aia-193 of current rotation (left) and previous rotation (right) showing reduced extent of CH32 (southeast quadrant)

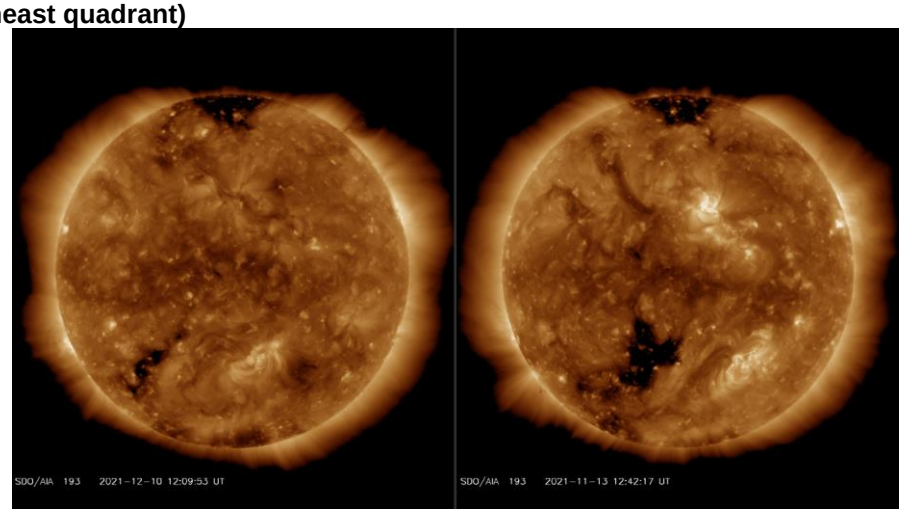
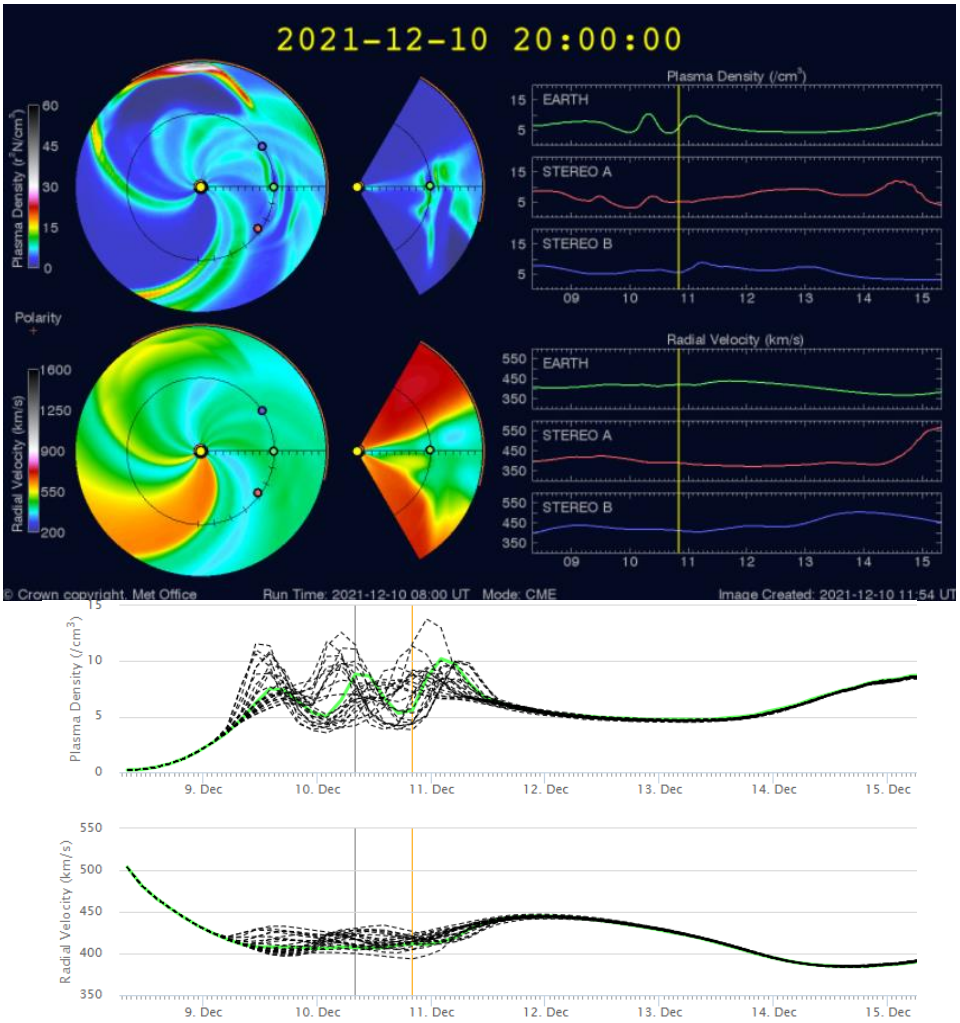


Figure 4: ENLIL and Ensemble, showing potential CME arrivals. First CME has likely missed.



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Radio Blackouts - X-Ray Flares:

Solar Activity has been at Very Low levels during the past 24 hours. There are currently no sunspot regions on the visible disc with activity anticipated to persist at Very Low levels.

A bright region of flux is visible on STEREO A euvi imagery, and is likely to rotate onto the visible disc day 3 or 4 (12th or 13th), although some influence is possible on day 2 if any activity occurs whilst still over the limb. Whilst it is uncertain that this region will contain any notable spots, this will bring a chance of activity increasing to Low.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	1	1	1	1
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 5: GOES-16/17 X-ray flux

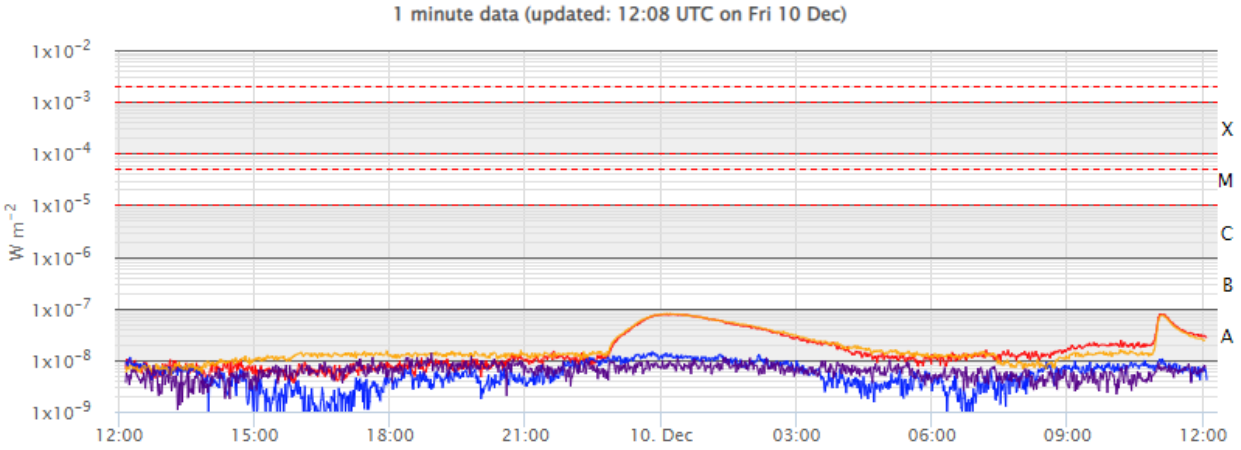

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Figure 6: STEREO A euvi imagery, showing bright Flux region in far southeast.

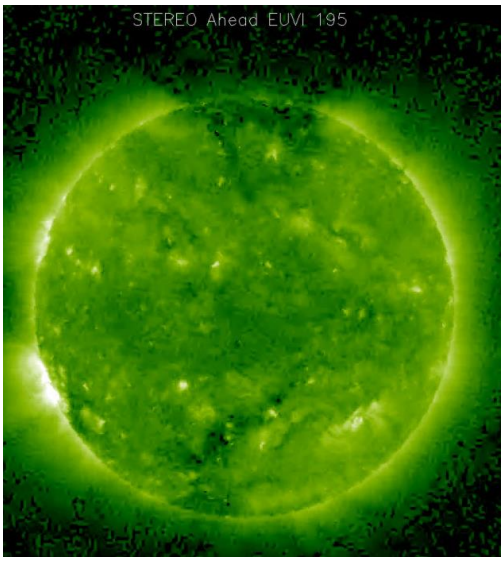
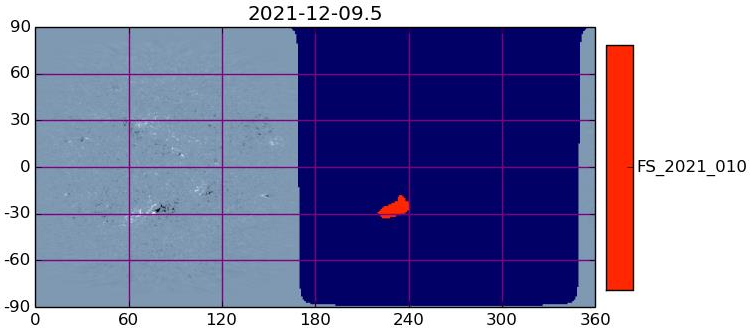


Figure 7: Notable region possible on far-side but likely 9-10 days away. (Helioseismic analysis)



Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is forecast to remain at background levels.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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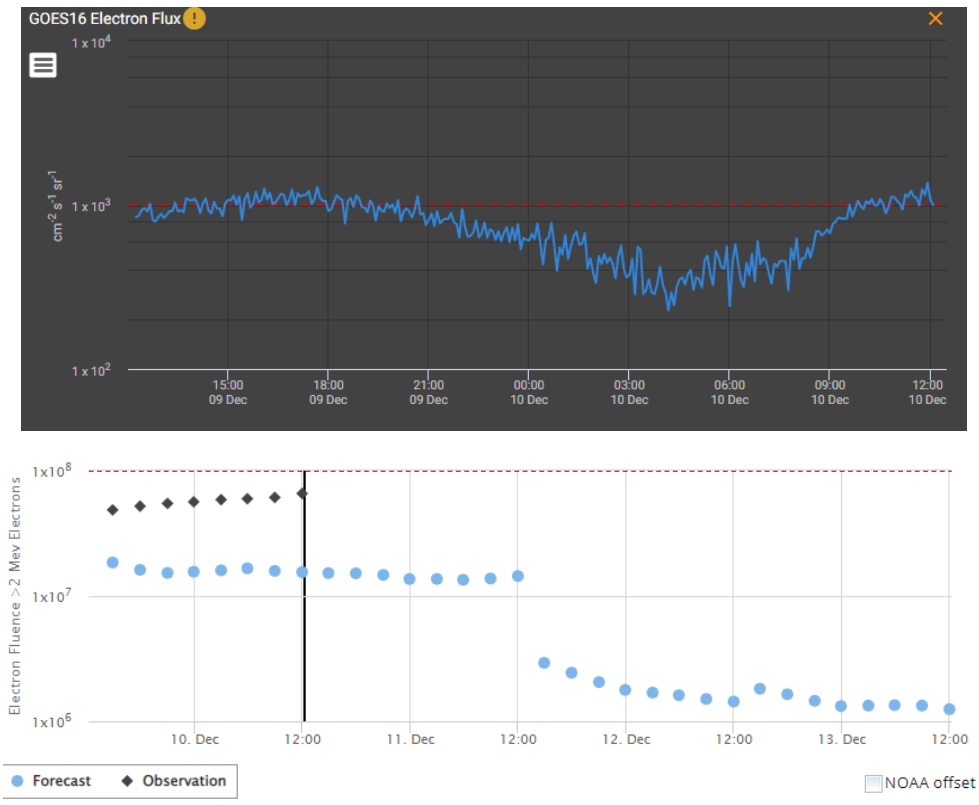
High Energy Electrons Event (≥ 2MeV):

The high energy electron flux (greater than 2 MeV) as observed by GOES-16 is currently Moderate to High across the diurnal cycle. Little change is anticipated through the period, with further spells of High levels anticipated each day during maximum. Any weak geomagnetic enhancements from the coronal holes, most likely late day 2 or early day 3 (11th or 12th), or the potential weak CME day 1 (10th) could lead to brief periods of drop out, but with a recovery in values.

The associated Fluence is expected to remain below the Active threshold throughout the forecast period, with a steady trend, although perhaps slightly rising day 1 and into day 2 (10th and 11th) before the influence of any geomagnetic activity causes any periods of reduced flux. This trend is similar to that shown in REFM, although at a slightly higher starting value.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	20	10	10
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 8: GOES-16 >2 MeV Electron Flux and associated Fluence with REFM.



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